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MINING CONDITIONS IN THE MOSCOW BASIN

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Classification of Roofs of Moscow Basin Coal Faces

In the Moscow basin it is customary to classify roofs of coal faces as heavy, medium, or light depending on the structure of the immediate roof. The roof is termed heavy if the layer of clay above the coal seam is not less than 4 meters thick, medium if it is from 1.5 to 4 meters thick, and light if it is less than 1.5 meters thick.

In the majority of faces of the basin the roofs are made up of numerous, comparatively thin layers, usually not exceeding 1.5 meters. One of the characteristics of the Moscow basin deposits is the extremely unstable make-up of the surrounding rock. Sand, sandy clay, and clay lie directly above the coal seam and are a factor in determining the stability of the roofs of the coal faces.

However, in the Moscow basin roofs of coal faces are often classified arbitrarily as stable, medium stable, and unstable, and as a result faces having roofs with analogous properties are sometimes assigned to different groups. The following table indicates the composition and thickness of the rock in the lower level of the immediate roof and gives, in percent of the total number of faces, the faces assigned to each category of roof:

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Thickness of Lower Layer of Immediate Roof (meters)	Stable Roofs				Medium Stable hoofs				Unstable Roofs			
	Clay	Sandy Clay	Sand	Shale	Clay	Sandy Clay	Sand	Shale	Clay	Sandy Clay	Sand	Shale
Up to 0.5	8.1	3.3	0.3	2.8	6.1	4.0	2.5	1.0	4.6	1.5	1.6	0.7
0.51-1.0	6.4	0.7	0.5	-	8.1	2.8	2.0	0.5	2.2	0.7	0.8	-
1.01-1.5	4.5	1.0	0.7	1.2	2.6	1.0	1.3	-	1.0	0.7	-	0.3
1.51-2.0	1.6	0.3	-	-	1.2	1.2	1.6	-	-	-	0.3	-
More than 2.0	3.1	3.8	-	0.3	0.3	2.0	2.1	-	0.3	-	6.4	-
Total	23.7	9.1	1.5	4.3	18.3	11.0	9.5	1.5	8.1	2.9	9.1	1.0

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In 1951, the Moscow Scientific Research Institute of Coal attempted to establish for the basin uniform, definite criteria for classifying roofs according to their stability and, at the same time, to delimit the range of each group. Geological data obtained in the mines and the results of observations carried out at the faces during the process of exposing the roofs provided material for the starting point of this project. The rock composition of face roofs was divided as shown in the following table:

Roof Rock Directly Adjacent to Coal Seam	No of Faces (%)
Clays	50
Sandy clays	23
Sand	20
Clayey and carbonaceous shale	7
Total	100

From the data in the above table it is clear that in 50 percent of the cases clays lie directly above the coal seam and only 7 percent of the faces have clayey and carbonaceous shale in the immediate roof of the coal seam. Under Moscow basin conditions, shales are usually friable, brittle, and lacking in plasticity. As a result, they are unstable and, in their mechanical properties, approach sandy clays. It is impractical to assign roofs containing shale to a special class of their own from the standpoint of stability. They are rather to be classed with the sandy clay roofs.

Thus, coal face roofs may be divided into three types depending on the composition of the strip immediately above the coal seam: clayey, sandy clayey, and sandy roofs. The degree of stability varies, depending on the presence of one type of rock or another in the roof. A roof is to be classified as stable if its composition permits safe mining operations when a portion of it has been exposed and no props have been installed. The dimensions of the exposed strip indicate the degree of stability.

In order to make a study of roof stability, representative faces of the Moscow basin were selected which contained rock of varying types and thicknesses in the layer directly above the coal seam. All other factors were approximately uniform. Twenty-four such faces were selected and, in addition, 27 faces were investigated which had strips of coal remaining in the roof and, above these strips, clay, sandy clay, or sand.

The condition of the roof was observed at each of these faces during two extraction cycles. At face No 11 of Mine No 4 of the Molotovugol' Trust, the thickness of the seam removed was 1.6 meters. The coal was of medium toughness, and the clay layer above the coal was from 0.4 to 1.7 meters thick. After the face had been cut with the cutting machine, 18 boreholes were blasted to a depth of 1.3 meters. As a result, the roof of the seam was exposed to a width of 1.1 meters and a length of 17 meters, that is, the unpropped area amounted to 18.7 square meters. At this part of the face, removal of the broken down coal was carried out for one hour and 20 minutes, during which time no props were installed under the exposed area of the roof.

At face No 10-12 of Mine No 34 of the Krasnoarmeyskugol' Trust, where the coal seam was 3.6 meters thick, 2.75 meters were removed; this left a protecting block of coal from 0.25 to 0.30 meter thick in the roof. Above the coal was a layer of dry sand. At this face also, the face was first cut with a cutting machine and then blasted. In forming a passage for the cutting machine an unpropped area 17 meters long and 0.9 meter wide was created. The extraction of the coal caused an exposed area 10 meters long and 1.6 meters wide, that is, an area of 16 square meters.

However, the width of the exposed area plays a very important part in determining how extensive this area may be. At the majority of faces in the basin it is possible to leave a strip 0.4-0.9 meter wide along the entire length of the face, that is, 50 meters long. In this case the exposed area amounts to 35-45 square meters, but with the increase of the width of the exposed strip, the permissible area of the unpropped section drops in size considerably. At faces with medium stable roofs, an exposed area 0.9 meter wide and 30 meters long proved feasible (face No 6, Mine No 9, Shchekinugol' Trust), that is, an area of 27 square meters. However, with the increase of the width of the unpropped area to 1.8 meters to accommodate the cutting machine, an exposure of only 3-4 meters along the length of the face was permitted, making a total area of 7 square meters. Similar cases occurred at nearly all faces under observation.

The following table gives data on the faces under observation, indicating the face number, the mine and trust to which it belongs, the content and thickness of the lower layer of the immediate roof, the dimensions of the exposed area of the roof, and the length of time the exposed area remained unpropped.

Trust	No of Mine	No of Face	Composition and Thickness of Rock in Lower Layer of Immediate Roof (meters)	Dimensions of Exposed Strip of Roof (meters) Max Width	Length	Time Without Props at Exposed Area (hr-min)
Molotov-ugol'	11	33-34	Clay 1.5	1.3	3	1-40
Molotov-ugol'	4	4-6	Clay 1.2	1.0	12	1-20
Bolokhov-ugol'	22	14-16	Clay 1.0	1.3	5	3-00
Bolokhov-ugol'	23	36	Clay 0.9	1.1	22	3-00
Molotov-ugol'	4	9-11	Clay 0.9	1.1	15	1-20
Molotov-ugol'	4	39-41	Clay 0.6	1.1	15	1-30
Bolokhov-ugol'	23	70-72	Clay 0.6	1.1	2.2	0-50
Bolokhov-ugol'	22	38	Clay 0.4	0.7	1.5	0-30

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Trust	No of Mine	No of Face	Composition and Thickness of Rock in Lower Layer of Immediate Roof (meters)	Dimensions of Exposed Strip of Roof (meters) Max Width	Length	Time Without Props at Exposed Area (hr-min)
Kalinin-ugol'	4	53	Clay 0.2	1.5	3	0-30
Shchekin-ugol'	19	98-100	Sandy clay 1.5	0.75	2	0-40
Donskoy-ugol'	40	10-12	Sandy clay 0.5	0.8	17	2-00
Donskoy-ugol'	25	23-24	Shale 0.6	0.5	14	3-00
Donskoy-ugol'	42	13-15	Shale 0.4	0.8	7	1-00
Molotov-ugol'	1	11-13	Coal 0.10 Sandy clay 0.25	1.4	12	1-50
Molotov-ugol'	8	62-64	Soft coal 0.2 Clay 0.3	1.0	7	1-20
Krasnoar-meyskugol'	34	10-12	Coal 0.3 Sand	1.6	13	2-00
Krasnoar-meyskugol'	34	2-4	Coal 0.4 Sand	1.5	7	0-30
Krasnoar-meyskugol'	37	20-22	Coal 0.3 Sandy clay	1.5	8	0-40
Kalinin-ugol'	36	45-47	Coal 0.12 Sand	1.5	2	0-20
Kalinin-ugol'	4	6	Coal 0.5 Clay 0.7	1.6	3	1-00
Shchekin-ugol'	8	13-15	Coal 0.3 Sandy clay 0.20	1.5	7	2-00
Shchekin-ugol'	11	50-52	Coal 0.3 Clay	1.6	6	2-30

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Trust	No of Mine	No of Face	Composition and Thickness of Rock in Lower Layer of Immediate Roof (meters)	Dimensions of Exposed Strip of Roof (meters) Max Width	Length	Time Without Props at Exposed Area (hr-min)
Shchekin-ugol'	19	94-96	Coal 1.5 Shale 0.2	1.7	2	6-00
Shchekin-ugol'	9	8-10	Coal 0.20 Sandy clay	1.3	20	1-30
Shchekin-ugol'	17	233-235	Coal 0.2 Clay 0.4	1.7	10	2-00
Stalino-gorskugol'	22	24-25	Coal 0.4 Clay 1.0	1.8	4	3-45
Stalino-gorskugol'	22	28-30	Coal 0.9 Clay 1.0	1.7	4	3-00
Bolokhov-ugol'	22	36	Coal 0.20 Sand	0.7	2.2	0-30

Moscow Basin Mine Uses Shch-50 Shield Effectively

Industrial experiments with the mobile, mechanized Shch-50 shield, designed by Ziglin and Giller, were carried out from November 1951 through May 1952 at Face No 40 of Mine No 3 of the Shchekinugol' Trust by the Tulaugol' Combine in collaboration with the Moscow Scientific Research Institute of Coal.

The shield was lowered into the mine, delivered to the working front, and set up. The Shch-50 shield is designed to support a narrow strip of the roof in the area near the face and to protect the working area from side obstructions caused by collapsing or falling rock. It consists of separate sections joined together by hinges. These sections are placed in a row along the face and are moved simultaneously with the aid of two winches in the passageways.

In mid-November 1951 the Shch-50 shield was set up at face No 40 of Mine No 3 of the Shchekinugol' Trust. In the section where it was installed there was a coal pillar 150 meters long. The face along this pillar was 20 meters long. The coal seam was 2.6-3.2 meters thick and contained coal of medium toughness, with one rock interlayer up to 10 centimeters thick. In the roof of the seam were clays from 0.5 to 2.5-4.0 meters thick and watery sand or sandy clay 3-4 meters thick in a limestone base.

During the 6-month experimentation period the shield advanced 151 meters and 12,327 tons of coal were mined. The average movement of the face where the shield was installed was 24 meters per month, as against an average of 22.9 meters per month for the other faces of the same mine. The actual advance rose from 14 meters in December 1951 to 36 meters in May 1952. The best daily advance, achieved on a schedule of three cycles per day, was 2.7 meters.

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The average daily output of coal for the entire experimentation period was 117 tons, but in May it reached 160-180 tons and, in the best periods, 236 tons (three cycles per day and a daily advance of the face of 2.7 meters). The daily yield of coal from one linear meter was 20-25 percent higher than at the other faces of Mine No 3.

Labor productivity rose from 2.26 tons in December 1951 to 4 tons in May 1952. During the period of operations on the schedule of one cycle per shift it reached 5.3 tons and, on specific exceptionally good days, 7-7.6 tons.

Results of experimentation in the use of the Shch-50 shield lead to the following conclusions:

1. The design of the shield is effective and, in its basic characteristics (maneuverability, adaptability to varying circumstances, mechanization of a number of work-consuming processes, dependable protection of the working area, almost complete elimination of mine timbers), it answers the main requirements for mobile mechanized props for the Moscow basin mines and for mines with similar mining and geological conditions.

2. The technical and economic indexes for work at the face with the shield were better than those achieved by other faces of the mine during the latter part of the experimentation period. After the elimination of certain apparent defects, such as the weakness of specific units, and after further gradual improvements have been made in the shield, it will be more economical to use the Shch-50 in mining than to use regular transferable mine props.

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